rôle of the fungi in endotrophic mycorhizas, as in *Acer*. The only adverse criticism to be made of this excellent paper concerns the mere detail of the use of the words symbiosis and heterotrophic. Heterotrophic is used for the case (*Tilia*) where the same root has ectotrophic and endotrophic mycorhizas, which certainly is not the usual sense of the word. Both McDOUGALL and FUCHS contrast parasitism and symbiosis, whereas etymology and the best usage make parasitism a kind of symbiosis.—H. C. COWLES.

Photo-growth reaction.—BLAAUW,[19] who has already proved himself a master in phototropism, now publishes an excellent piece of work on the effect of illumination on the growth of the sporangiophore of *Phycomyces*. He uses the term "photo-growth reaction" to indicate the changes in growth rate and amount caused by a single short application of light. He first works with equilateral illumination applied at right angles to the organ from four or eight directions. The quantity of illumination in the different experiments varies from 1 to 7,680,000 M.K.S. In all cases an early acceleration in growth is followed by a later retardation. In illumination of 16 M.K.S. and above the acceleration begins about 3.5 minutes after the beginning of illumination. In 1 M.K.S. it begins after 8 minutes, and in 6 M.K.S. after 6 minutes. The maximum acceleration was at about 7 minutes in 16 M.K.S. and above and later in lower quantities. Then follows a gradual fall in growth rate until a rate considerably below the normal is reached, and then a gradual rise until the normal rate is again reached. The duration, amount, and overlapping of these reactions vary much with the amount of illumination. In some of the lower light amounts the total acceleration exceeds the total retardation by threefold, while in the higher amounts the latter exceeds the former. This agrees with the finding of JACOBI that slight illumination (low intensities of medium duration or high intensities of short duration) accelerate growth, while medium or great amounts of illumination retard growth. JACOBI deals with only the difference of the accelerating and retarding effects, since she took her readings 24 hours after exposure. BLAAUW'S work gives the continuous curves. In all the older works only the retarding effect had been reported. BLAAUW finds that for low light quantities, where the accelerating does not overlap the retarding effect, a quantitative relation can be found between quantity of stimulus and quantity of acceleration. The increased growth is proportional to the cube root of the light amount. JACOBI'S conclusion that the quantity of stimulus law does not apply here is due to her failure to recognize that both effects (accelerating and retarding) appeared in every application, and that she was dealing only with their difference.

In a second group of experiments BLAAUW deals with phototropic response in the same organ, and with good evidence comes to the conclusion that phototropism in this form can be explained entirely by the total of the "photo-growth reactions." This brings us back to the old view of DE CANDOLLE under

[19] BLAAUW, A. H., Licht und Wachstum I. Zeitsch. Bot. 6:641–703. 1914.

a more complex garb. BLAAUW's work clearly indicates that the amount of effective light and not the direction of the ray is the determining factor in phototropism. He believes NOAK'S[20] opposing view is due to his overlooking the parabolic curve of the tip in the epicotyl of *Avena*, the shading effect of the sporangia of *Phycomyces* on the perceptive and growth regions of the sporangiophore, and the cylindrical lens effect of the latter organ. On account of its lens action the back of the organ in unilateral light is more strongly illuminated than the front. The matter is rendered more complex by the focal line lying at different depths with variation in the angle of the incident ray.—WILLIAM CROCKER.

The vegetation of Natal.—Perhaps no part of the world is theoretically more interesting and practically less known to the phytogeographer than South Africa, and it is a satisfaction to record the appearance of two excellent papers on the vegetation of Natal by Professor BEWS[21, 22] of the Natal University College. The first paper is of general nature, presenting the ecological factors and plant associations of the province as a whole. Although Natal is situated considerably to the south of the Tropic of Capricorn, much of the area is frostless and has a distinctly tropical vegetation. Especially is this true of the coast, where are to be found such tropical types as the mangroves and Pescaprae. Almost all of the coast line is fringed by dunes, reaching a height of 50–200 feet, and covered chiefly by xerophytic bush. The vegetation of the interior is mostly evergreen dicotylous forest and grassland. The forest (generally called bush) resembles SCHIMPER'S sclerophyll forests, except that they are in regions of summer rather than winter rain. Perhaps the most interesting type of bush is the yellow-wood bush, in which *Podocarpus* dominates. In the Natal bush epiphytes are relatively scarce, but lianas are very abundant. Transitional to the grassland or veld is the thorn veld, essentially a savanna, with a dominance of umbrella-shaped *Acacia* trees. In the veld the grasses are changing, largely because of human influences, and it is noteworthy that the invading grasses are less useful to man than the original grasses. A brief account is given of the marsh or vlei and of secondary associations, that is, those due to human influence.

The second paper is the initial one of a series contemplated by BEWS, dealing in detail with the vegetation of small areas in the province of Natal. In the veld the dominating natural grass is *Anthistiria imberbis;* increasing areas are being given over to the cultivation of wattle (*Acacia mollissima*)

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[20] BOT. GAZ. **58**:88–89. 1914.

[21] BEWS, J. W., The vegetation of Natal. Annals of the Natal Museum **2**[3]:253–331. *pls. 10.* 1912.

[22] ———, An ecological survey of the midlands of Natal, with special reference to the Pietermaritzburg district. Annals of the Natal Museum **2**[4]:485–545. *pls. 7. map 1.* 1913.